

The University of Wisconsin-Madison Multidisciplinary Graduate Certificate in Patient Safety

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Abstract

A graduate-level certificate in patient safety has been developed at the University of Wisconsin-Madison (UW-Madison) as part of the university's AHRQ-funded Developmental Center for Evaluation and Research in Patient Safety, which is known as the Systems Engineering Initiative for Patient Safety (SEIPS). This patient safety certificate, which is open to all graduate students enrolled at UW-Madison, combines course work from the departments of industrial engineering, population health sciences, and medical physics, as well as the school of pharmacy, school of nursing, and the law school. The course work covers the following areas: basic patient safety terms, concepts, and statistics; medical error causation; human error; tools to assess safety and risk; systems design principles; safety culture; measurement of risk; and analysis of safety and risk. It also covers technology used to improve patient safety, human factors engineering as applied to patient safety, finance/economics of patient safety, organizations involved in patient safety, medication use process and safety, implications of medication errors, teamwork in health care, and medical error reporting. The patient safety certificate requires five courses, including three core patient safety courses, a patient safety practicum, and a patient safety guest lecture seminar. The practicum is designed to allow students to spend a semester at various health care organizations (hospital, outpatient clinic, long-term care facility, and home care), where individual students will participate in patient safety projects related to analysis, design, and/or implementation.

Introduction

Over the past few years, various studies have left no doubt that patient safety is a national priority.^{1,2} Suggestions to improve patient safety have included system redesign, error reporting systems, information technology, and improved safety culture. While these suggestions are sound, some have argued that to truly improve patient safety, changes are needed in the way health care professionals are educated and in their educational curriculum.³ According to one recent national survey, however, few undergraduate and graduate medical programs are incorporating patient safety into medical education.⁴ The purpose of this chapter is to review the current literature describing patient safety education and to describe an innovative patient safety curriculum for nurses, pharmacists, allied

Report Documentation Page			Form Approved OMB No. 0704-0188		
Public reporting burden for the collection of information is estimated to average 1 hour per response, including the time for reviewing instructions, searching existing data sources, gathering and maintaining the data needed, and completing and reviewing the collection of information. Send comments regarding this burden estimate or any other aspect of this collection of information, including suggestions for reducing this burden, to Washington Headquarters Services, Directorate for Information Operations and Reports, 1215 Jefferson Davis Highway, Suite 1204, Arlington VA 22202-4302. Respondents should be aware that notwithstanding any other provision of law, no person shall be subject to a penalty for failing to comply with a collection of information if it does not display a currently valid OMB control number.					
1. REPORT DATE 2005		2. REPORT TYPE N/A		3. DATES COVERED -	
4. TITLE AND SUBTITLE The University of Wisconsin-Madison Multidisciplinary Graduate Certificate in Patient Safety				5a. CONTRACT NUMBER	
				5b. GRANT NUMBER	
				5c. PROGRAM ELEMENT NUMBER	
6. AUTHOR(S)				5d. PROJECT NUMBER	
				5e. TASK NUMBER	
				5f. WORK UNIT NUMBER	
7. PERFORMING ORGANIZATION NAME(S) AND ADDRESS(ES) Agency for Healthcare Research and Quality 540 Gaither Road, Suite 2000 Rockville, MD 20850				8. PERFORMING ORGANIZATION REPORT NUMBER	
9. SPONSORING/MONITORING AGENCY NAME(S) AND ADDRESS(ES)				10. SPONSOR/MONITOR'S ACRONYM(S)	
				11. SPONSOR/MONITOR'S REPORT NUMBER(S)	
12. DISTRIBUTION/AVAILABILITY STATEMENT Approved for public release, distribution unlimited					
13. SUPPLEMENTARY NOTES Published in Advances in Patient Safety: From Research to Implementation. Volumes 1-4, AHRQ Publication Nos. 050021 (1-4). February 2005. Agency for Healthcare Research and Quality, Rockville, MD. http://www.ahrq.gov/qual/advances/.					
14. ABSTRACT					
15. SUBJECT TERMS					
16. SECURITY CLASSIFICATION OF:			17. LIMITATION OF ABSTRACT UU	18. NUMBER OF PAGES 14	19a. NAME OF RESPONSIBLE PERSON
a. REPORT unclassified	b. ABSTRACT unclassified	c. THIS PAGE unclassified			

health professionals, and engineers that represents an improvement in both patient safety teaching methods and content.

Educational efforts in patient safety

Most publications on patient safety education have focused on the type of content to provide to the health care professionals of tomorrow. In a comprehensive patient safety educational needs assessment, VanGeest and Cummins⁵ identified curriculum topics from nurse and physician focus groups and surveys. Though the response rates to the surveys were low (nurses: 34 percent, physicians: 12 percent), the results nonetheless provide some initial insight into what some practicing health care professionals see as gaps in current health professional educational curricula. Among physician focus group participants, suggested patient safety topics included the following: *health care error* and *patient safety* definitions, technology and patient safety, human factors (dealing with complexity, product design, and fatigue), physician-patient communication, communication within the health care team, learning from mistakes, disclosure of errors and injuries to patients and families, financial and legal implications of health care error, error as an issue in medical education, and the need for systems thinking and cultural change. The physicians' top-ranked topics were proven medication safety practices; legal, tort, and malpractice issues; nonpunitive environments and systems for error reporting; safety practices; and ethical issues. The bottom five-ranked topics were designing jobs for safety, methods for making safety a systemwide objective, establishing and promoting interdisciplinary teams to address patient safety, models of error identification, and theories of human error.

The nurse focus groups and survey respondents showed some similarities to the physician groups, but they also displayed important differences. The nurses in the focus groups identified the following topics for a patient safety curriculum: ethics (transparency and truthfulness), a proactive approach to error in health care, framing mistakes (i.e., the system vs. individual), reporting error and follow-up, learning from mistakes, staffing issues and error, technology and error, mentoring in nursing education, and patient education. The nurse survey respondents' top five curriculum topics were as follows: proven medication safety practices, designing jobs for safety, ethical issues, nonpunitive environments and systems for reporting errors, and models for constructively dealing with unsafe practices. The bottom five topics were methods of disclosure to patients, family, and/or media; establishing and promoting interdisciplinary teams; models for error identification; patient safety in nonhospital settings; and theories of human error. The possible causes of the similarities and differences in focus group and survey respondent rankings between the nurses and physicians were not addressed by the study authors.

Aside from the works of VanGeest and Cummins, few other publications on patient safety education have so thoroughly assessed the needs from the perspectives of physicians and nurses. However, other publications have provided

guidance for patient safety curriculum content. Barach, for example, described a 1-month patient safety elective for anesthesia residents in Harvard Medical School-affiliated programs that focused on human error, error-reporting, system assessment, human factors engineering, and medical simulation.⁶ Dickey called for modifying all aspects of medical education from the perspective of patient safety and error reduction.⁷ She believed that curricula should include what is known about errors, the impact of errors on patient and care systems, and methods to control errors. She also felt that students should be taught about the latest information technology that can be used to reduce errors, how to design systems with proper defenses against errors, and communication skills.

Several authors have suggested educating health care professionals about patient safety through informatics curricula. Gosbee and his colleagues^{8–10} have argued that human factors engineering should be the basis for a practical curriculum on medical error and that it should be part of an informatics course. By educating this way, they believed that students could provide feedback on—and better evaluate and select—medical software and devices. According to Gosbee and his colleagues, topics for the curriculum should include the following:

- Understanding the scope and gravity of error in health care settings.
- Gaining a familiarity with human perceptual limitations and cognitive biases (as well as learning that they are uncontrollable, yet very predictable).
- Knowing theoretical and practical reasons why “blame and train” and “bad apples” approaches fail.
- Understanding the importance of discovering root cause toward proper countermeasures.
- Becoming familiar with human factors engineering and continuous quality improvement techniques that determine root causes and help design countermeasures.
- Understanding major categories of error countermeasures.
- Understanding limitations and pitfalls of automation as a countermeasure.
- Understanding that some latent errors and systemic problems are exacerbated by poor design.

This curriculum was taught as a month-long elective rotation for 4th year medical students and residents and was a required month-long course for doctor of pharmacy students. Nursing students received the training as part of a nursing informatics course composed of three 1-hour sessions. Gosbee also has discussed a resident-oriented patient safety curriculum that was developed by the Veterans Health Administration National Center for Patient Safety.¹¹ That curriculum teaches a patient safety overview, human factors engineering, patient safety interventions, usability testing, and root-cause analysis as part of self-contained

modules. Other researchers have called for similar topics to be part of nursing informatics curricula¹² and undergraduate medical education.¹³

One of the most well-formulated curricula is described for emergency medicine residents.^{14, 15} The authors suggest that the curriculum should focus on decisionmaking, cognitive science theory, and evidence-based medicine. Furthermore, they suggest that educators develop skills in human factors engineering, information technology, and high-fidelity patient simulation. There are seven topics in the curriculum, and each is described with a suggested format for delivering the educational content. First is awareness of medical error, which is taught using lecture format, small group discussion, a video, and a series of readings. The second topic, definitions and models of errors, includes teaching awareness about models of accident and hazard analysis (e.g., failure modes and effects analysis) as well as about safety models outside of health care. The third section is on cognitive error and medical decisionmaking. This topic includes models of medical decisionmaking, how mistakes are made in decisionmaking, and how cognitive errors can be prevented. The authors recommend using case-based teaching for this topic. The fourth topic is learning from the experiences of others, while the fifth topic is complications from invasive procedures. Number six is medical error from a systems perspective, a topic that includes error models, system definitions, system contributions to error, the emergency department (ED) system, high-risk and high-reliability organizations, teamwork, information networks, equipment failure, and control strategies. The final topic is living with the reality of medical error. The goal of the curriculum is not necessarily to educate, but to enlighten and motivate. The developers advocate incorporating the content into existing areas of the curriculum, such as diagnosis and treatment, or presenting the material in case conferences. The authors also note that even though people argue that systems problems contribute to medical errors, the curriculum is weighted toward human error because physicians are more familiar with human errors than systems errors.

Schools of pharmacy also are attempting to add patient safety content to their curricula. The survey conducted by Johnson et al.¹⁶ revealed that 44 percent (15 of 34) of the responding schools of pharmacy had some form of medication error instruction in their curricula, yet the course format (didactic, lab, combination) as well as the quality and quantity of the instruction were variable. Medication error course work was categorized under six domains: human factors research, medical errors, medication errors, quality or process improvement, root-cause analysis, and failure mode and effects analysis. A substantial number of the responding schools indicated that the following domains were not taught in their curriculum: human factors research (44 percent), medical errors (32 percent), root-cause analysis (62 percent), and failure mode and effects analysis (79 percent). The authors noted, "The study illustrates the need for schools of pharmacy to articulate and standardize a minimal level of medication error instruction."

Undergraduate and graduate medical, nursing, and pharmacy education have not been the only targets for patient safety content. Elkin and Gorman¹⁷ call for teaching patient safety as part of continuing medical education (CME). They

suggest that CME courses on patient safety teach system structures of health care and that they focus on adverse drug events, errors of omission and commission, discharge planning, transitions in levels of care, consultation, preoperative evaluations, and safety of herb-drug interactions. Other suggested continuing education patient safety course topics, specifically for nurses, have included raising competencies in the system and removing cultural tolerance for errors and for barriers to reporting.¹⁸

The U.S. Federal Government also has efforts underway to improve patient safety education. The Agency for Healthcare Research and Quality (AHRQ) and the Department of Veterans Affairs (VA) have partnered to offer a program to train a Patient Safety Improvement Corps (PSIC).¹⁹ The target audience for this training program is State departments of health staff who are patient safety officers or who are responsible for patient safety reporting, analysis, and intervention. Hospital partners selected by States also are eligible. The goal of the program is to provide the knowledge and skills necessary to conduct medical error investigations, identify root causes of medical errors, prepare meaningful reports on medical error investigations, develop and implement system interventions to control medical errors, measure and evaluate the impact of system interventions, and ensure the sustainability of effective interventions. The program enrolls participants annually for three 1-week training sessions.

The patient safety education literature that was reviewed yields several patterns. First, the curricula proposed are presented as being part of fairly short courses. The content typically is covered in 1-month elective courses or is squeezed into existing courses, thus limiting the time that can be spent on patient safety. This reflects the realities of current health care professional education. There is little content flexibility, and many topics are competing with patient safety for time. Second, in most cases the target audiences for the proposed curricula consist of narrowly defined groups such as anesthesia residents, emergency medicine residents, or nursing students (although most of the curricula likely could also be used for educating other health care professionals). Third, the content proposed by the various authors has considerable overlap. Human error, error reporting, error prevention, systems understanding, human factors engineering, and an understanding of how information technology can contribute to or control errors were common to most proposals. In order to overcome the short time frames and narrow audiences of other programs, while simultaneously building on the strengths of the content proposed, a patient safety curriculum at the University of Wisconsin-Madison (UW-Madison) has been designed. An important feature of the curriculum is the close collaboration between various health care disciplines and the engineering field in defining and delivering the curriculum content. The remainder of this paper presents this new, innovative patient safety curriculum.

UW-Madison SEIPS graduate certificate in patient safety

Background

The UW-Madison Center for Quality and Productivity Improvement was awarded a Developmental Center for Evaluation and Research in Patient Safety grant by AHRQ. The center is known as the Systems Engineering Initiative in Patient Safety (SEIPS).²⁰ The SEIPS team proposed to develop a university-sanctioned graduate certificate in patient safety that would provide intensive patient safety training to graduate-level nurses, pharmacists, allied health professionals, health services researchers, epidemiologists, and engineers. Medical students and residents were intentionally left out at this early stage of curriculum development because they lacked the flexibility in their schedules to pursue a multisemester patient safety curriculum.

At UW-Madison, a graduate certificate curriculum typically consists of five to seven semester-long courses in a focused area of study. (A typical semester-long course meets for 2.5 hours per week for 16 weeks.) The area of focus typically is not one provided by any single department. Instead, the certificate curriculum is made up of courses from several departments that, together, make up the focus area.

Invitations to join an exploratory steering committee were sent to faculty teaching courses deemed relevant to patient safety. These faculty members taught courses on human factors engineering, patient safety risk assessment, medication safety, accident causation and analysis, quality of health care, and health care systems design. The group agreed that a patient safety curriculum should have a multidisciplinary foundation with a systems engineering focus. The group also sought to develop a curriculum that would provide intensive training through semester-long courses (instead of short 1-month courses) and that would allow a diverse target audience to learn together. The eight faculty members assembled for the steering committee represented five colleges and schools (engineering, nursing, medicine, pharmacy, letters and sciences) and were affiliated with the following organizations or fields:

- Industrial engineering
- Population health sciences
- School of Nursing
- School of Pharmacy
- Medical physics
- Center for Demography and Ecology
- Biomedical engineering
- Center for Quality and Productivity Improvement
- Center for Health Systems Research and Analysis
- Wisconsin Comprehensive Cancer Center
- Industrial Relations Institute
- Institute on Aging

The committee held a series of meetings to explore the idea of creating a graduate certificate in patient safety. It was agreed that there was a market demand for patient safety-trained individuals, so the details of the certificate were discussed over the next series of meetings. In addition, the committee concluded that the teaching and research activities in patient safety at UW-Madison were sufficiently strong and developed to ensure the delivery of the patient safety certificate.

The committee decided that the major emphasis of this certificate would be to increase student knowledge about systems engineering and systems design principles for the purposes of identifying, analyzing, and solving patient safety problems. This focus is unique in that systems engineering, in addition to human factors engineering, will be emphasized to the students. This focus also reflects the unique diversity in the curriculum faculty. This curriculum is based on collaboration between faculty in industrial engineering (who specialize in systems and human factors engineering) and a variety of health care disciplines. Students will take required semester-long courses from professors of industrial and systems engineering, human factors engineering, pharmacy, population health sciences, and medical physics. Electives will be available from professors of nursing and law in addition to those from the aforementioned disciplines. To help emphasize the systems engineering and human factors engineering focus, the committee decided to administratively house the certificate in the Department of Industrial Engineering.

The steering committee faculty designed the certificate to allow students in a range of disciplines in health care and engineering an opportunity to gain advanced knowledge in patient safety. The main target audience consists of nurses, pharmacists, epidemiologists, and industrial engineers. Students in these specialties are increasingly being called upon to assume patient safety duties, such as serving as a patient safety officer or a patient safety committee member in health care delivery institutions. In addition, just like physicians, their work in health care has a direct impact on patient safety, so it is critical to provide these individuals with the opportunity to gain advanced knowledge on the topic. Medical students and residents can enroll in the certificate program if their schedule allows them to commit to five to seven semester-long courses. Medical students and residents are currently able to enroll in the core courses of the certificate, such as the course on Quality of Health Care, which is cross-listed in the departments of Population Health Sciences and Industrial Engineering.

The curriculum

To enroll, students must be accepted into a graduate or professional degree program and may be either full- or part-time. As a prerequisite, students must (1) have a degree in a health care-related field (e.g., nursing, medicine, pharmacy, population health sciences, public health, health care administration, health systems management, health care management); (2) have worked in health care delivery; **or** (3) have taken a course in health care delivery (e.g., Introduction to Health Systems Engineering, Health Care Systems, or Health Systems and Health

Care Delivery). Core faculty will determine if a student has met the prerequisite requirement. Three prerequisite options are offered in order to allow people with and without health care backgrounds to pursue the certificate in patient safety.

The certificate in patient safety requires 15–17 credits, 12–14 of which come from core or otherwise mandatory course work. Table 1 presents the mandatory portion of the curriculum.

Together, the mandatory portion of the curriculum covers the following topics:

- Systems engineering ideas, theories, and methods
- Medical error causation
- Safety tools to assess safety and risk
- Culture
- Analysis of safety and risk
- Medical error reporting
- Organizations involved in patient safety
- Implications of medication errors
- Basic patient safety terms, concepts, and statistics
- Quality improvement from the engineering perspective
- Human factors engineering as applied to patient safety
- Human error
- Systems design principles
- Measurement of risk
- Automation used to improve patient safety
- Finance/economics of patient safety
- Medication use process and safety
- Teamwork in health care
- Quality improvement from the health care perspective

One of the three mandatory core courses, Pharmacy 490: Medication Use Safety, is currently offered to students in the schools of pharmacy, nursing, and medicine, as well as in the Department of Industrial Engineering. It is designed to study the problems of medication errors in health care by examining methods of assessment, intervention implementation, and quality management. This was chosen to be a core course because medication errors are one of the leading risks to patient safety, they can result in significant harm, the percentage of patients receiving medication management is growing, and the complexity of the therapeutic management and medication use systems is increasing. It also was chosen because the content covers identification, analysis, and control of medication errors.

Table 1. Mandatory portions of the certificate in patient safety curriculum

Mandatory Certificate Courses	Credits
1. Every student enrolled in the certificate program must attend Friday morning patient safety research seminars sponsored by the Systems Engineering Initiative in Patient Safety at UW-Madison. These 1-credit, hour-long seminars occur once a month and feature presenters covering a variety of patient safety topics.	1
<p>2. All students enrolled in the curriculum must complete the equivalent of a 15-day patient safety practicum during one of their semesters in graduate school. To meet this requirement, students will be expected to work on an actual patient safety project with a health care delivery organization (in-patient, out-patient, long-term care, home care, etc.). They will be involved in the design, measurement, analysis, implementation, and/or evaluation of the patient safety project. There are three ways to fulfill this requirement:</p> <p>a. If a student works for a health care delivery organization and is working on such a project for the minimum equivalent of 15 days in a semester, that work can count toward the requirement if approved by the advisor.</p> <p>b. If a student must complete a project for another course, and that project is a patient safety project that requires the equivalent of 15 days of work throughout the semester, that work can count toward the requirement if approved by the advisor.</p> <p>c. If a student does not otherwise have access to a patient safety project, he or she will be able to sign up for a 2-credit patient safety practicum. Core faculty of the certificate program will assist in placing the student in a health care delivery organization.</p> <p>Students meeting “a” or “b” above will not have to sign up for the 2-credit practicum, will fulfill the requirement, and will complete a total of 15 credits for the certificate. Students needing to take the practicum will complete the certificate with a total of 17 credits.</p>	0
3. Each student must take Pharmacy 490: Medication Use Safety, which covers systems design and human factors engineering topics related to the safe preparation and delivery of medications.	3
4. Each student must take Medical Physics 559: Patient Safety and Error Reduction in Healthcare, which covers patient safety analytical tools developed by safety and systems engineers.	2
5. Each student must take Population Health Sciences 703: Quality of Health Care, which covers quality improvement techniques applicable to safety improvement, and is taught jointly by medical school and industrial engineering faculty.	3
<p>6. Every student must take at least one of the following courses, each of which teaches essential systems and human factors engineering ideas, theories, and methods:</p> <p>a. Industrial Engineering 549: Advanced Human Factors Engineering</p> <p>b. Industrial Engineering 555: Accident Causation and Analysis</p> <p>c. Industrial Engineering 652: Sociotechnical Systems</p> <p>d. Industrial Engineering 653: Job and Organizational Design</p>	3
TOTAL	12–14

The semester-long course is offered to students from multiple disciplines and taught by a multidisciplinary faculty (pharmacists, nurses, industrial engineers, physicians, quality assurance practitioners, and a patient advocate). Students

receive their lectures via CD-ROM and gather weekly for interactive discussion-and-problem-solving sessions. The students are divided into groups to ensure representation from each discipline and to encourage positive team dynamics. The students are graded on written assignments and group projects—no exams are administered. The group project is a sentinel event that the team manages from investigation and documentation through intervention design, implementation, and assessment. The course content is sequenced as follows: systems problem identification, error reporting, intervention design and implementation, and the understanding of assessment tools and performance improvement techniques.

Another mandatory core course, Medical Physics 559: Patient Safety and Error Reduction in Health Care, is cross-listed by the departments of medical physics and industrial engineering and led by a professor of medical physics. Faculty from the Medical School, School of Pharmacy, and Department of Industrial Engineering teach the content, which is focused on tools and methods for patient safety analysis. This course discusses the nature and magnitude of hazards to patients in various health care settings. It also presents the student with techniques to analyze risks and address problems in order to reduce errors and create a safe patient-care environment. Particular tools discussed include probabilistic risk assessment methods, failure mode and effects analysis, human factors analysis and error classification systems, and quality management. Studies in the clinical world are anchored by discussions of patient safety standards, recommendations from agencies, and continual quality improvement, along with examples of how to apply the tools in a variety of health care settings. This course was chosen as a core course because its instructor team is multidisciplinary and the course content emphasizes systems methods, tools, and solutions for improving patient safety.

The third mandatory core course, Population Health Sciences 703: Quality of Health Care, is cross-listed by the departments of population health sciences and industrial engineering and is taught by two physicians and two industrial engineers. This course is composed of four modules covering the conceptual foundations for medical professionalism and human factors/systems engineering as well as applications of these concepts to provider behavioral change, systemic change, and technological change. The course integrates multiple disciplines to present a variety of approaches to health care quality. Similarities, differences, and conflicts between these approaches are strongly emphasized in the teaching.

The two physician instructors teach the professional role of the provider, clinical quality assurance, provider behavioral change, and clinical decisionmaking. The two engineering instructors teach the human factors engineering, systems engineering, and sociotechnical systems components. This course requires the interdisciplinary synthesis of these ideas into a single project that students complete in small teams. Students with a health care background are paired with engineering students to solve a real-world patient safety or quality-of-care problem. The final exam includes oral and poster presentations, based on the team project, that are open and advertised to the public.

Depending on whether or not a student needs to take the two-credit practicum (as described in Table 1), he or she will still need 1 or 3 credits beyond the mandatory portion of the curriculum. Those credit hours can be fulfilled by enrolling in either a relevant independent study or an additional course from the elective list. Elective courses must be approved for each student by his or her advisor. The electives from which students may choose (with advisor approval) are shown in Table 2. They are listed by department.

The breadth and depth of coverage in the curriculum will provide students pursuing the certificate in patient safety with the knowledge and skills required to be hired as a hospital patient safety officer or to fill any other position that requires an understanding of patient safety. The curriculum will be launched during the 2004–2005 academic year.

Table 2. Elective courses for the patient safety certificate

<p>History of Medicine</p> <ul style="list-style-type: none"> • Ethical and Regulatory Issues in Clinical Investigation <p>Law School</p> <ul style="list-style-type: none"> • Center for Patient Partnerships <p>Industrial Engineering</p> <ul style="list-style-type: none"> • Introduction to Human Factors Engineering • Engineering Management • Advanced Human Factors Engineering • Human Performance and Accident Causation • Occupational Safety and Health • Introduction to Quality Engineering • Planning Large-scale Complex Systems • Health Information Systems • Sociotechnical Systems • Organization and Job Design • Introduction to Health Systems Engineering • Technology Implementation • Human Error • Human Factors and Patient Safety Seminar 	<p>Nursing</p> <ul style="list-style-type: none"> • Organizational Influences on Interdisciplinary Practice • Health Program Planning, Evaluation, and Quality Improvement • Ethics and the Responsible Conduct of Research <p>Population Health Sciences</p> <ul style="list-style-type: none"> • Economics of Health Care • Seminar—Contemporary Issues in Health Care • Introduction to Health Services Research • Strategy and Methods in Epidemiology • Epidemiologic Methodology • Quantitative Methods in Population Health • Epidemiology of Chronic Diseases • Monitoring Population Health • Assessment of Medical Technologies
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Conclusions

There is a clear need to educate health care students on patient safety. If this does not happen, efforts to reduce medical errors and injuries will continue to encounter barriers stemming from a lack of awareness and a lack of relevant knowledge and skills. Fortunately, there is a growing, though still small, body of literature that discusses proposals for patient safety curricula. These are important first steps, even if these curricula are confined to 1-month electives or are part of other ongoing courses. At the very least, they raise awareness of the issues. But current efforts to integrate patient safety into existing curricula will likely be more inspirational than educational, because developing real knowledge and skills in a topic requires more intensive training. The UW-Madison SEIPS certificate in patient safety was designed to provide intensive training. In addition, the certificate in patient safety focuses on systems engineering and human factors engineering, which, as discussed, some have argued should be the basis for patient safety curricula. The developers of the certificate hope to successfully train the patient safety officers, information technology project leaders, medical device decisionmakers, care givers, and health systems engineers of the future to be able to accurately identify, analyze, and solve patient safety problems in order to improve care for all patients.

Acknowledgments

This work was funded in part by a grant from the Agency for Healthcare Research and Quality, # P20 HS11561-01 (P. Carayon, principal investigator).

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